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INFLUENCE OF PARTICIPATION IN A 9-WEEK PHYSICAL TRAINING INSTRUCTORS COURSE ON SELECTED ANTHROPOMETRIC AND PHYSICAL FITNESS VARIABLES

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ABSTRACT

A nine-week study was undertaken to determine the effects of the Joint Physical Training Instructors Course (JPTIC) on selected anthropometric and physical fitness variables in 20 graduating students. The course programme consisted of 10 periods of 40 minutes each. The time was divided between theoretical knowledge and practical instruction. All candidates underwent the standardised Total Fitness Test as well as an anthropometric evaluation at the beginning, middle and end of the course. Changes in the standardized Total Fitness Test and the anthropometric variables were recorded. The following measured parameters improved with statistical significance: percentage body fat ($\rho < 0.001$), fat mass ($\rho < 0.001$), flexibility ($\rho < 0.001$), cardio respiratory fitness- 2.4km run ($\rho < 0.001$) and 4km walk ($\rho < 0.001$), muscular strength/endurance- sit-ups ($p= 0.003$) and pull-ups ($p= 0.000$) and agility ($p= 0.001$). No significant improvement was observed in the shuttle runs ($p=0.954$), push-ups (0.059), static push-ups ($p=0.551$) as well as in the explosive power ($p=1.00$). It can be concluded that although the JPTIC yielded positive changes on many fitness and anthropometric variables a larger strength component should be included in the training to ensure greater positive changes specifically in muscular strength and muscular endurance.

Key words: Anthropometric, physical fitness variables, Physical Training Instructors Course, physical training instructors' programme, total fitness test.

INTRODUCTION

Despite increased automation and mechanisation in the military field, a high level of physical fitness remains a crucial requirement for soldiers to be able to do their jobs effectively (Harwood, Rayson & Nevill, 1999).

In a military context, physical fitness is defined as the capacity to meet the demands of the occupation and of the unit missions. The required levels of physical fitness can be achieved by selecting personnel with the right potential and by appropriate physical training (PT) that complies with the basic principles of progression, overload, recovery and reversibility (NATO Technical Report AC/243, (Panel 8) TR/16, 1994). A major consideration in the conception, design and construction of any military programme should be both the potential for improvement and the transfer of any fitness gains to enhance military performance (Jones, Cowan, Tomlinson, Robinson, Polly & Frykman, 1993).

The Joint Physical Training Instructors Course (JPTIC) is a 9-week training course designed to develop candidates in both the theory and practice of physical training, ultimately providing the SANDF with highly qualified Physical Training Instructors. Students range from the early twenties to middle thirties and have to obtain a pass mark of 60% in the standardized fitness test to be accepted for the course. The course involves academic training as well as a rigorous physical training programme.

The latter includes cardiovascular exercise, muscular endurance and muscular strength training. Water survival training and swimming make up a significant portion of the early training schedule and has a two-fold purpose. Firstly, it promotes the development of cardiovascular fitness, and secondly, it exemplifies a non-weight bearing activity through which fitness can be achieved.

Three components of physical fitness have been identified as particularly relevant to military performance: aerobic/cardiovascular fitness, muscular strength/power and muscular endurance (Harwood *et al.*, 1999). Body mass and composition are additional factors that indirectly affect military performance. Military training, therefore, should be directed at improving these components of fitness (Harwood *et al.*, 1999). The JPTIC provides a mixture of cardiovascular, muscular strength and muscular endurance training in a controlled environment. The body's response to physical activity has been found to be directly related to the training programme that the subject is required to complete (Nelsen, Arnall & Loy, 1990; Chromiak & Mulvaney, 1990). Previous studies have evaluated the efficacy of Army Training in improving physical fitness (Legg & Duggan, 1996; Brock & Legg, 1997; Williams, Rayson & Jones, 1999). However, these studies have focused on the basic training of regular army recruits rather than on members who are being trained as Physical Training Instructors. These studies often focused on aerobic/cardiovascular fitness and excluded the other relevant fitness components. Currently, no information is available on the effect of the JPTIC on the anthropometric and physical fitness variables of individuals. The purpose of this study was to determine the influence of participation in a 9-week JPTIC course programme on the anthropometric and physical variables of the graduating students.

The programme

The course programme consisted of 10 periods of 40 minutes each. The time was divided between theoretical knowledge and practical instruction. The practical instruction included participation in physical activities, which addressed the development of fitness components, and

also required students to act as physical instructors. The latter was aimed at developing their class presentation skills. For the purpose of this study, only a breakdown of the physical activities will be given, as the aim of the study was to determine the influence of participation on physical variables. A complete breakdown of the scheduled physical activities is outlined in Table 1.

METHOD

The course group consisted of a total of 20 graduating students. There were 18 men and 2 women of an average age of 28 years. These individuals participated in the standard 9-week JPTIC. All candidates underwent the standardized Total Fitness Test as well as an anthropometric evaluation at the beginning, middle and end of the course. The result of the final Total Fitness Test contributed to their Overall Fitness Evaluation mark. The Total Fitness Test covered the following fitness components:

Flexibility: Modified sit-and-reach test (cm)
Cardio respiratory fitness: 2.4km run (min.) (SG NO 6/2000); 4km walk (min.) (SG NO 6/2000)
Special cardio respiratory fitness: 21km run in PT Kit (minutes)
Muscular strength/endurance: Sit-ups (repetitions) (Barrow, McGee & Tritscher, 1989); Push-ups (repetitions) (Heyward, 2002); Pull-ups (men-repetitions) (Ted & Andrews, 1999); Modified pull-ups (women - repetitions) (Ted & Andrews, 1999); Static push-ups (seconds) (Heyward, 2002)
Explosive power: Sergeant's/Vertical jump (cm) (Bosco & Gustafson, 1983)
Agility: SEMO agility test (seconds) (Morrow, Jackson, Disch & Mood, 2000)

The anthropometric evaluation included measuring each subject's weight (kg); height (cm); percentage body fat analysis (Heath-Carter method), calf and biceps circumferences (cm), and humerus and femur widths (cm). The latter were measured to determine each member's somatotype (Heath & Carter, 1967).

Analysis

The data was analysed using a non-parametric statistical technique for repeated measures, namely the Friedman Test. This test is analogous to the parametric repeated ANOVA and is used to detect differences in the fitness variables across the three time periods. Non-directional post hoc comparisons were made using a Wilcoxon test to detect the exact differences between the

time periods. The Alpha value was adjusted using Bonferroni's inequality (i.e. $\alpha = .017$) to take into account the potential for increased Type I error as a result of repeated measures (Pett, 1997).

Table 1: Breakdown of scheduled physical activities.

Fitness Component	Activity	Description	Amount	No. of hours
Cardiovascular	Swimming	Swimming lengths	1.5km	
		Water activities	17 sessions	13.3
	Running (PT kit)	Long slow distance	201.8km	33.6
		Interval training	26km	4.3
		Steps	2 sessions x 40min	1.2
		Running with poles	6km	0.5
	Running (battle kit)	Running with full battle kit	12 km	1.12
	Walking	Walking with full kit	15km	52.16
	Total time spent on cardiovascular component			**66.7**
Muscular endurance	Gym training	Circuit	4 sessions	2.6
	Program	Series of muscular endurance exercises	44 sessions	29.3
	Total time spent on muscular endurance component			**31.9**
Muscular strength	Gymnastics	Gymnastic activities	16 sessions	10.6
	Program	Series of muscular strength exercises	33 sessions	22
	Total time spent on muscular strength component			**32.6**

RESULTS AND DISCUSSION

Subjects

Of the 20 subjects included in the study, 90% were male and 10% were female. It was decided to include only the data of the males in the final analysis. Furthermore, two males were excluded from the study owing to data typing errors or missing data. A data set of 16 men was finally analysed.

The ages of the men ranged from 22 – 36 years, with an average of 28 years. More than half of the subjects (56%) were between 24 years and 30 years of age. Just over a third of the men (31%) were between 31 – 36 years old. Only 12% of the men were younger than 24 years. It can be concluded that the JPTIC has a significant influence on seven of the anthropometric and physiological components (see Table 2).

Anthropometric Evaluation

Participation in a cardiovascular exercise programme has been linked to weight loss and a decrease in percentage body fat. At the beginning of the course, the average weight of the group was 64.5 kg. (The range was 29kg with a minimum of 53 kg and a maximum of 82.2kg.) The average weight during the second and third measurements was almost similar, i.e. 62.93 kg and 62.84 kg, respectively. The group spent 66.7 hours on cardiovascular fitness. (See Table 2) On average, the men lost 1.5 kg during the 9 weeks of training.

Percentage body fat is defined as the portion of total body mass that is fat tissue and can be estimated using skin-folds. Over the three time periods a significant difference ($\rho < 0.001$) in the percentage of body fat was found with the Friedman test. Post hoc analysis using the Wilcoxon test showed significant differences between the first and second measurement ($\rho<0.01$), the first and third measurement ($\rho>0.01$), and the second and third measurements ($\rho<0.01$). The average percentage body fat dropped from 10.27 at the first measurement to 8.89 at the second and 8.03 at the third measurements.

Table 2: Significant changes in physiological components.

	Wilcoxon	Average – First Evaluation	Average – Third Evaluation
Anthropometric:			
Percentage body fat	($\rho<0.01$)	10.27	8.03
Fat mass	($\rho<0.01$)	6.33	4.97
Flexibility			
Sit and reach	($\rho<0.01$)	13.12 cm	14.84 cm
Special cardio respiratory fitness			
21 km run (Second to third evaluation)	($\rho<0.01$)	96.23 min	88.2 min
Muscular strength / Endurance			
Sit-ups	($\rho<0.01$)	63.25	75.0

It can thus be concluded that the JPTIC has a significant effect on the percentage body fat of the students. An elite male athlete is categorized as excellent if his percentage body fat is 7% (Morrow *et al.*, 2000).

Significant differences were detected in fat mass evaluations between the time periods ($\rho < 0.01$) with the first and second evaluation ($\rho<0.01$). The first and third evaluation ($\rho<0.01$) and the second and third evaluation ($\rho<0.01$) differed significantly. Fat mass dropped from 6.33 (first evaluation) to 5.16 (second evaluation) to 4.97 (third evaluation), with an average drop of 1.36 from the first to the last measurement.

No significant differences between the time periods were detected for Lean Body Mass ($\rho<0.1$), Ideal Fat Mass ($\rho<0.1$) and Ideal Body Mass ($\rho<0.1$), indicating no significant effect of the JPTIC on these fitness components.

Flexibility

The JPTIC has a significant effect ($\rho<0.01$) on flexibility as measured by the sit-and-reach test. Flexibility improved significantly from the initial measurement to the middle measurement ($\rho<0.01$) and from the middle to the last measurement ($\rho<0.01$). At the beginning of the course an average of 13.12 cm was reached. This was increased to 16.81 cm at the middle measurement, but dropped to 14.84 at the final measurement. In spite of an apparent decrease towards the third measurement, the increase from first to last measurement was still significant ($\rho<0.01$).

Cardio respiratory fitness

Cardio-respiratory fitness improved significantly following the JPTIC as measured by the 2.4 km run ($\rho<0.01$) and the 4 km walk ($\rho<0.01$). At the beginning of the course it took the students on average 9.36 minutes to complete the 2.4 km run. At the end of the course they completed it in 8.66 minutes. This is a significant difference ($\rho<0.01$). Although no significant difference ($\rho>0.1$) was found between the first and second evaluation (9.36 min. - first evaluation - to 9.09 min. - second evaluation), a

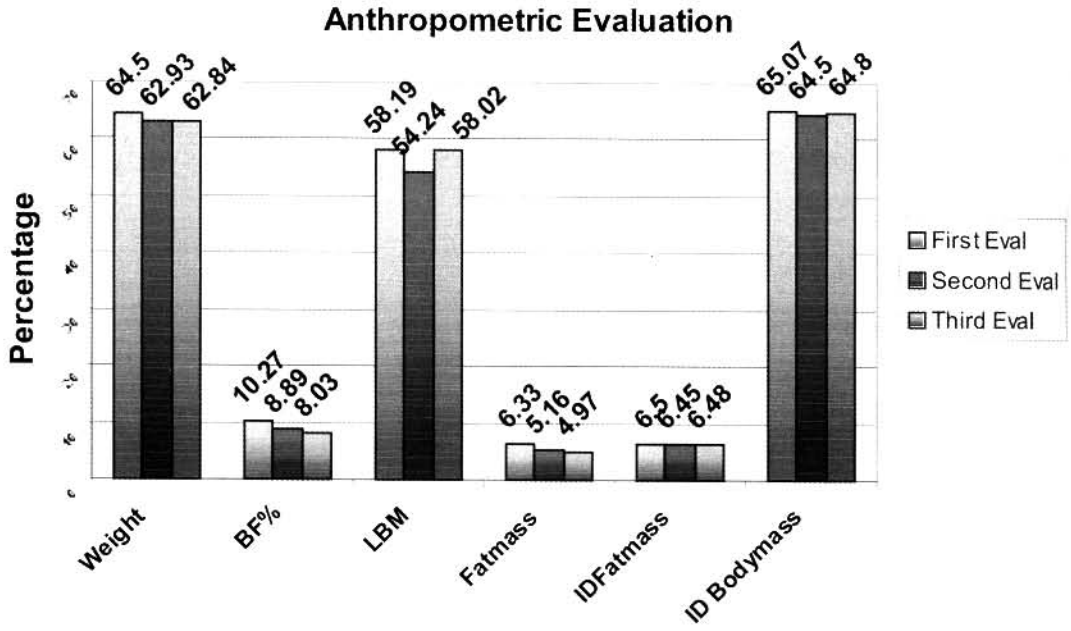

Figure 1: Anthropometric parameters from first to third evaluation.

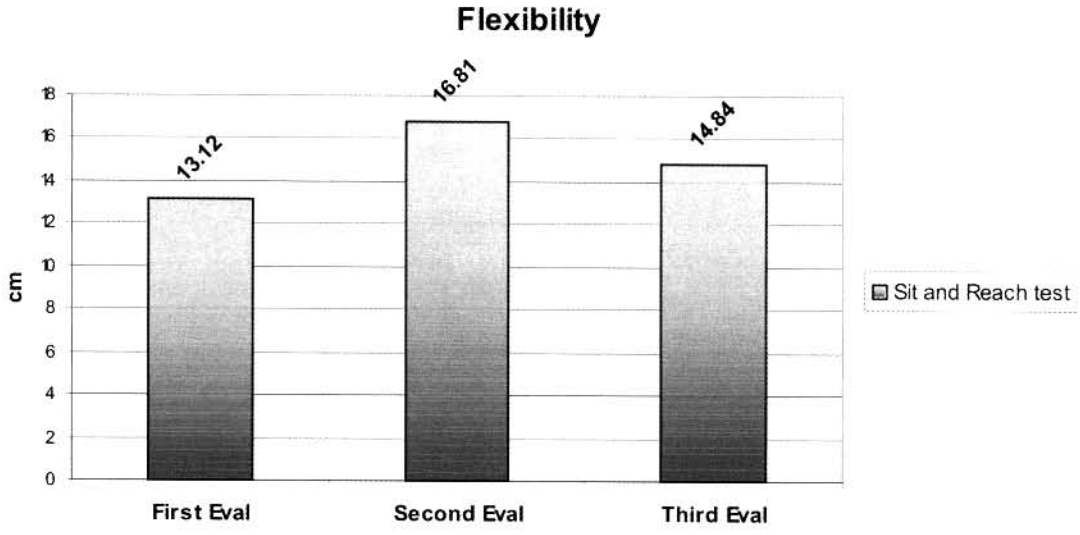

Figure 2: Flexibility parameter from first to third evaluation.

significant decrease in time was detected ($\rho<0.01$) from the second evaluation (9.09 min on average) to the third evaluation (8.66 min).

This was also the case with the 2.4 walk where the time decreased significantly from the first to the last measurement ($\rho<0.01$), and from the middle to the last measurement ($\rho<0.01$), but not from the first to the middle measurement ($\rho<0.1$). It took the students on average 25.88 min. to complete the 4 km walk at the beginning of the course. The time improved significantly towards the end of the course when it took them only 24.58 min. It can be concluded that the JPTIC significantly improved cardio respiratory fitness.

Special cardio respiratory fitness

This fitness component consists of the 3 km and the 21 km run. The 3 km run, however, did not take place and for the 21 km run, only a second and third evaluation was done. A significant difference was detected between the middle and last evaluation ($\rho<0.01$). On average, the men took 96.23 min to complete the 21km run during the middle evaluation and 88.2 min at the end of the course. On average, they decreased their time by 8 min, an indication that the fitness course did have a significant effect on this fitness component.

Muscular strength/Endurance

The exercises that were used to measure this fitness component are shuttle runs, sit-ups, push-ups, static push-ups and pull-ups.

The analysis showed that only sit-ups ($\rho<0.01$) and pull-ups ($\rho<0.01$) were improved significantly from the beginning to the end of the course. The students did an average of 63 sit-ups at the beginning of the course and improved significantly to 75 repetitions towards the middle of the course. No significant improvement was noted during the second half of the course, at which stage the subjects could complete an average of 76.9 repetitions. In the case of pull-ups, the students did 8 repetitions on average at the beginning of the course and improved significantly towards the middle of the course ($\rho<0.01$) with 10.75 repetitions on average. This figure improved slightly (not significantly)

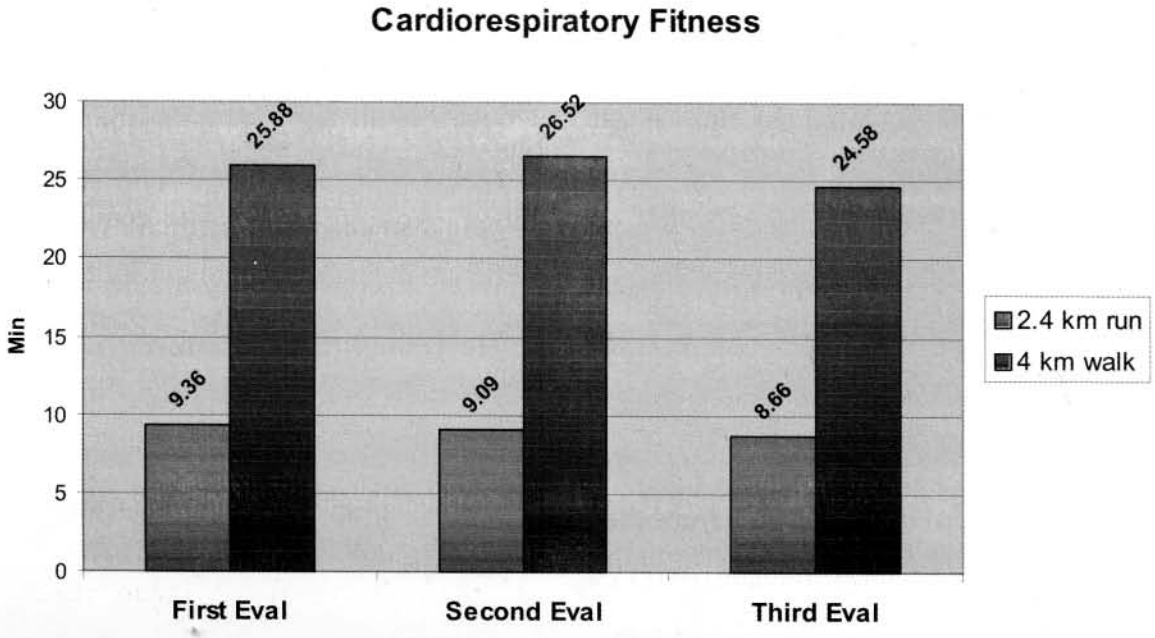

Figure 3: Cardio respiratory fitness parameters from first to third evaluation.

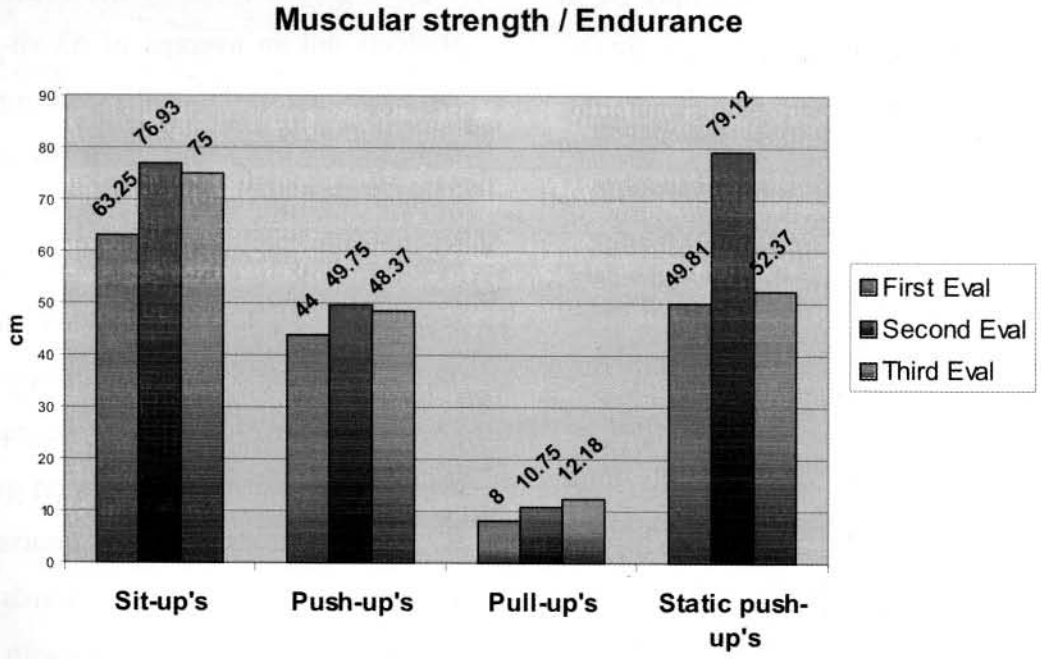

Figure 4: Muscular strength and endurance parameters from first to third evaluation.

($\rho>0.1$) to 12.18 repetitions towards the end of the course. The number of shuttle runs did not improve significantly ($\rho>0.1$) from the first to the last evaluation the subjects averaged 54 at the beginning and 54.7 at the end of the course. During the middle evaluation the group performed 55.6 shuttle runs.

The students could not improve the number of push-ups significantly from the first to the last measurement ($\rho>0.1$). At the beginning of the course, they did 44 push-ups on average and increased this to 48.3 by the end of the course. During the middle measurement they averaged 49.7, which showed a slight deterioration towards the end of the course. In the case of static push-ups, no significant improvement was detected from the beginning to the end of the course ($\rho>0.1$). The average of 49.8 repetitions at the beginning was improved to 52.4 towards the end. It is interesting to note that on average the group did 79 static push-ups during the middle measurement and showed a significant deterioration ($\rho<0.01$) towards the end of the course.

Explosive power

The sergeant's/vertical jump was used to measure this component. Analysis showed that there was no significant improvement during the course ($\rho>0.1$). During the first measurement, 42.12 cm was reached and at the end of the course, the average for the group was still 42.4 cm.

Agility

The SEMO agility test was used for this evaluation. A significant improvement took place from the beginning to the end of the course ($\rho<0.01$). The students improved their time from 12.5 sec. at the beginning, to 11.79 sec. by the end of the course. A significant improvement was observed from the first to the middle measurements ($\rho<0.01$) where the average was 11.85 sec.

CONCLUSION

It can be concluded that although the JPTIC yielded positive changes on many of the fitness and anthropometric variables a larger strength component should be included in the training to ensure greater positive changes specifically in muscular strength and muscular endurance.

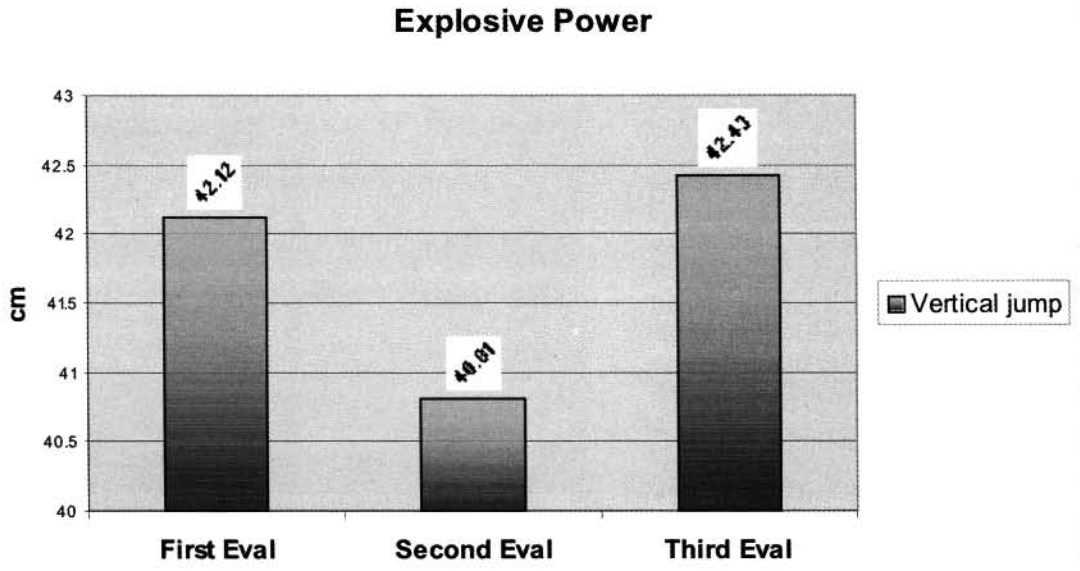

Figure 5: Explosive power parameter from first to third evaluation.

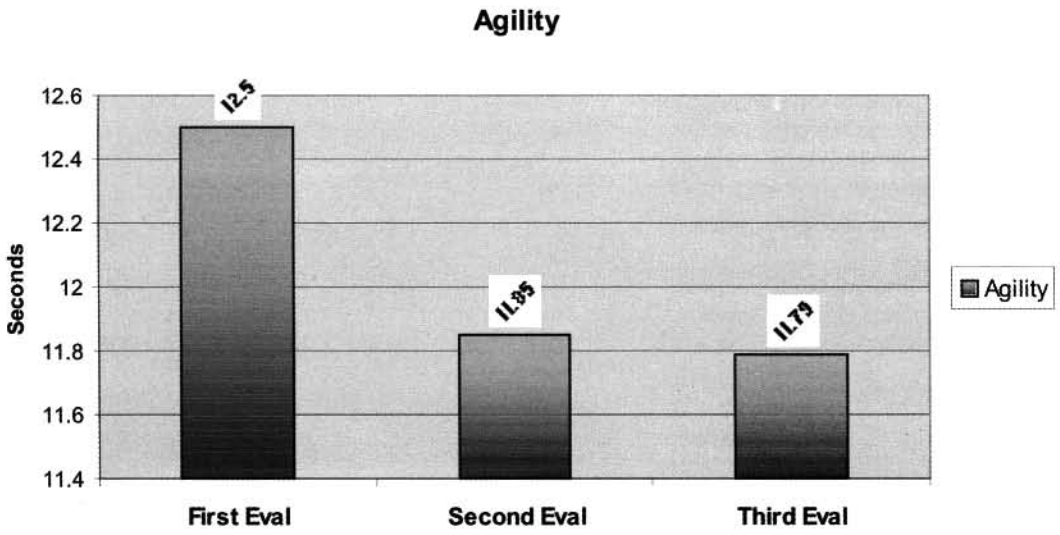

Figure 6: Agility parameter from first to third evaluation.

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